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ABSTRACT

In spite of the lack of specific and properly defined goals and plans about the use of computers for their development, some non-industrialized countries have made substantial advances in this computer usage. In these countries, the number of computers installed ranges from zero to roughly 1 per 200,000 inhabitants. The distribution of these systems among areas of application (business and commercial engineering and scientific, education and training, military and defense), is fairly similar to that observed in advanced countries. The majority of the developing countries have installed computers of varying capacities in some of their higher learning institutions, which is acting as a triggering factor for more and better computer installations. The upper bracket of the industrial, commercial and services enterprises of a substantial part of these countries have installed computer systems. The use of automatic data processing systems has initiated a revolution in management attitudes and techniques. There is, in almost all of the developing countries a strong tendency to increase the use of computers in government operations. (Author)

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RESOURCE PAPER
ON
APPLICATION OF COMPUTERS AND COMPUTING TECHNIQUES TO DEVELOPMENT, IN DEVELOPING COUNTRIES

SERGIO F. BELTRAN
(MEXICO)

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INSTITUTO
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COMPUTACION

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INTRODUCTION

1.1. When the problems related to the development and transfer of computing sciences and technology in developing countries should be examined, it is convenient to set-up an appropiate frame of reference within which both, the pertinent characteristics of development and the general existing conditions in these countries, can be defined and evaluated.

In this way, it is possible to establish the most desirable trends and the best recommendations can be suggested.

1.1. The author considers that the most important features of an adequate frame of reference are the following:

1.1.1. a) Development requires changes and transformations, not simply expansion of the existing production, services and educational facilities.

b) Changes and transformations include not only those in capital and consumer goods, in public and private services and in management methods, but also in attitudes and in the ways and means with which things are done in industrial and commercial practices, as well as in sociological relationships. And, as a result, in the whole of the socio-economic structures.

c) The only way of inducing necessary changes and transformations in developing countries is through innovation.

And innovation is only possible if there is " new understanding", and " understanding the new ".

d) With the present state of scientific and technological development, and in particular, considering the impact that " new " computer science and technology has in any process of development, it is necessary for developing countries not only to have a high and extensive capacity to understand the exogenously originated computer related science and technology, but also to strive to establish certain amount of endogenously created " new understanding " about the applications that computing technology should find in their processes of development.

e. Sound policies for both requirements can be implemented, when it becomes generally recognized that innovation includes invention, which is the creation of ideas and their reduction to practice.

Innovation, thus, consists in the rational bringing of inventions into widespread and useful utilization.

f) A last, but not least, consideration is to realize that the best mechanism for the introduction of innovation is what has come to be known as " coupling ".

Coupling is the complex mechanism through which an effective and active dialogue between the originators and the users of inventions takes place.

1.1.2. General local characteristics.

The great variety of degrees of development among non-industrialized countries, makes it extremely difficult to establish a set of " universal " characteristics from which sound recommendations for a programme to strenghten international co-operation and to encourage the use of computer science and technology for development, could be set forth.

But as natural, any attempt to establish them (even if it turns out to be a partially inadequate or incomplete effort) can always serve a useful purpose.

a. An important stumbling block in any effort to encourage a rational and scientifically formulated use of computer and data processing science and technology for the acceleration of the process of development, is the fragmentary (even inexistent in some cases) degree of definition of the major objectives of the national economic, social and cultural development.

b. As a result, it is difficult for developing countries to establish well-balanced, financially feasible and rationally implemented and coordinated plans (encompassing governmental, paragovernmental and private needs) for the-acquisition, installation, utilization, up-grading and changeover of computing and data processing facilities.

c. A major consideration is also that, in general, - a very high " social " cost is attached to the installation of every computing system, as compared with what is true for economically advanced countries.

This " social " cost is a result not only of the unfavorable rates of exchange between local currencies and -- the foreign currencies in which these equipments have to be paid, but also in the priorities in the utilization of - -- " hard " divisas and, perhaps more crucial, in the fact that labor costs are still much lower than those in advanced countries and, which, at least partially, have served some of the manufacturers for establishing the rental and purchase prices of computing and data processing gear.

This last fact makes it much more difficult to justify a relatively substantial expenditure in this kind of -- equipment (even if clearly defined objectives and tasks in favor of their installation and use for development are established) vis a vis the cost of realizing many of them -- with manual help of qualified and semi-qualified personnel- whose trainning has been started, in many cases, since very few years back.

1.1.3. The average degree of inneficiency in the utilization of computing and data processing systems is higher than that found in advanced countries. The subutilization and misutilization of these equipments is a factor of great importance in diminishing their impact on the process of development.

Some of the most important factors related to this phenomenon are listed in the following paragraphs.

1.1.4. Developing countries wishing to get ahead in computer science and technology find themselves gripping not only with the two classical problems or hardware and software but also with two extra ones which the author has baptized as *hard-software* and *soft-hardware*.

1.1.5. The hard-software problem consists mainly in the impossibility of understanding, of " debugging ", and of introducing adequate or needed modifications in the software (operating systems, compiler translators, utility routines, application oriented packages, etc.) provided by the local representatives of manufacturers.

This is mainly due to three factors: the lack - - -

of knowledge and sophistication from the part of the user's personnel, an even worse lack of deep and operational knowledge about these items from the part of the manufacturer's local branches personnel, and the sales oriented " once-installed, once-forgotten " attitude that in general, these vendor's branches have to resort to as a result of their own situation within developing countries.

1.1.6. The soft-hardware consists in the numerous and varied interfaces and auxiliary custom-made equipment that developing countries should be technically capable to develop in order to up-grade already installed computing gear with more recent pieces of equipment.

Some related considerations are pertinent:

As natural, amortization (in real terms) of data-processing systems, takes a longer period in these countries than it takes in advanced ones. As a result, in many instances it could be much better for a " second generation installation " to be able to design and build interfaces for, let us say, connecting to it modern conversational or remote batch stations, then to spend the significant quantities involved in shifting to a " third generation " system with all the costly burden of reprogramming, retraining and increase in costs.

Unfortunately, the great majority of developing countries find themselves without the proper personnel and techniques for the development of these interfaces and of the auxiliary equipment, because design and construction of digital electronic equipment is usually an area grossly neglected in their higher education and technological institutions.

The end results is that in these countries the real-governing factor in the decision to purchase or rent a computer system and in establishing the " turn-over " of data processing equipment is the agresiveness and drive from -- the sales forces of the manufacturers.

1.1.7. This last condition is aggravated by the lack- of experienced enough people which could help in elaborating sound and sober evaluations of different available - - equipments and rational judgements about their most desirable or useful utilization.

1.1.8 The scarcity of properly trained personnel extends (in some cases representing quite an acute problem) to every one of the areas related with the installation -- and utilization of the computing systems.

All developing countries experience dramatic short - ages not only in programmers and systems analysts and de--

signers, but also in maintenance technicians, in operators, in managers of data processing centers, and even in technicians with the necessary training and experience to secure sound air-conditioning systems and trouble-free electrical installations.

2. THE RESULTS ALREADY OBTAINED

1.2.1. In spite of the lack of specific and properly defined goals and plans ~~of~~ about the use of computers for their development, some non-industrialized countries have made substantial advances in using these equipments properly.

1.2.2. In these countries, the number of computers installed goes from zero to roughly 1 per 200,000 inhabitants. (In economically advanced countries this index runs from 1 per 50,000 to 1 per 5,000 inhabitants). The distribution of these systems among areas of application (business and commercial, engineering and scientific, education and training, military and defence), is fairly similar to that observed in advanced countries. The reason is that the local agencies of vendors follow, in general, the patterns known for the countries of origin. The slightly relative larger percentage of computer systems devoted to business, commercial and clerical applications in developing countries, is-a reflection of their weakness in their use in engineering and scientific work, their slowness in utilizing computers in education and training, and their almost non existent (fortunately) computer based military and defence research.

In any event, an idea of in how an incipient stage the utilization of computers is in developing countries, can be derived from the fact that a rough world-wide average in automatic computing capacity can be set in about 2 to 3 operations per second *per cápita*, while not even the most advanced among the developing countries reaches an average above 9.5. operations per second *per cápita*. (In advanced countries this index runs as high as 20 to 30 operations/inhabitant).

1.2.3. The advances reached in some of the developing countries can be summarized in the following way:

a. The majority of these countries have installed computers of varying capacities in some of their higher learning institutions.

b. This has provided the basis for the integration of small, selected groups of advanced students and progressive professionals, which have been exposed to, and are utilizing extensively and intensively, the computing machinery and technology. Nowadays, these groups are acting as triggering factors for more and better computer-installations. But in general, there is still a long stretch-- to be covered until the large majorities of students become -- conversant with the variety of computer applications.

c. The upper bracket of the industrial, commercial and - services enterprises of a substantial part of these countries; have installed or are in the process of installing, computer - systems.

And even in those cases where these enterprises are owned by, or are branches of, larger foreign consortiums, the use of automatic data processing systems has initiated a revolution - in management attitudes and techniques.

d. There is, in almost all of the developing countries a strong tendency to increase the use of computers in government operations.

The extent of the benefits derived from this fact will -- undoubtedly be of extreme importance.

The (still slow) evolution in the tax structures, in -- the handling of population files, in better allocation of financial resources, in more rational control of foreign divisas, in more efficient methods for the transportation and distribution of consumer goods, in the scientific location of plants and urban developments, in accurate surveys of natural resources, is already having a revolutionary impact in the transformations required for development.

e. In the field of international cooperation, developing countries have also made substantial progresses. As natural, a large percentage of their international activities is polarized towards those, from the economically advanced countries, which are very active in computer science and technology. But exchange among them has been increasing along the last 5 - 6 years, and relations with active international organizations (IFIF, IFAC, ISIS (previously FID), etc.) have been also steadily increasing.

f. During the last 5 - 6 years, it has also been noticeable the sharp increase in the number of foreign experts from advanced countries which travel, visit, advice or teach in developing countries.

UNESCO has been an important factor in fostering this stream of expertise and, as can easily been constatated, it has proven quite an important factor in raising the technical level of utilization of computer and data-processing gear.

g. Last, but not least, comes the advances made in the high level training of selected personnel in universities and research centers of advanced countries. As it is well known, this is a very necessary and convenient policy, even if it involves the high risk of losing a substantial amount of the students, which remain in the recipient country for large periods, and even for ever.

As it is proven by the statistics published by the most advanced countries, the absolute figures of undergraduates who travel for the specific purpose of obtaining academic degrees or high-level training in reputable institutions of the advanced countries in Computing Sciences has increased more than ten-fold in the last 8 years, probably surpassing today the figure of 600.

1.2.4. Summing up, it is anyway necessary to point out that there is a broad gamma of " degrees of achievements " to the encountered. As the definition of " developing country " itself is so loose as to encompass from Poland to Bolivia and Paraguay, and from Mexico to New Guinea and Ceylon, it is only natural to find out countries where no computing systems has been installed as yet, and countries where a substantial activity in computer science and technology is under current development.

Logically, this is a major difficulty in the design and implementation of a world-wide program through which the United Nations could play a significant role in furthering - the efforts of developing countries for the application of - computer technology to development.

1.3 PROBLEM AREAS

1.3.1. As it is evident, the previous material includes references to several of the problems which the use of computing and data processing equipment poses to developing countries. Anyway, and for the sake of easier reference, the following order would be kept in the following comments about these subjects:

a. Educational and training.
b. Assesment and decisional.
c. Installation and operation.
d. Up-grading, betterment and changeover-of computing gear.
e. Software acquisition and consulting services.
f. Financial and social implications.

1.3.2. Educational and training

a. As it is known, there are more than 4000 universities and high-learning institutions all over the world. The total registration in these institutions surpasses the figure of 16 million students.

b. The total number of these institutions which are equipped with computing and data processing systems falls somewhere between 800 and 1000.

As natural, the largest part of them are institutions established in economically advanced countries.

If an estimation is made about the number of students exposed to computer science and technology within high-learning institutions in developing countries, it is evident -- that the figure is extremely low. Not only because of the - small percentage of universities possesing computing equipment, but also because of the more limited percentage of -- the total students population which is reached, and gets interested, and the relatively modest capacity of the installed equipment.

1.3.3. As a result of these circumstances and of the - scarcity of top-level professors and instructors, a substantial number of the computing centers within these universities have fatally fostered the creation of " elites "- and small groups of technicians, which after some time - - might even have a negative influence in the dissemination - of widespread knowledge and use of data processing facilities and techniques.

In a scientific and technological field as diversified and as rapidly envolving as this, progress and development depends largely on securing massive affluence of -- people interested in the applications of computers in all -

and every one of their actual and potential fields of interest.

1.3.4. This is more so, when there is a special interest in the application of computers to economic and social development, as it is well known that the degree of dependance of these computer applications on data-gathering, adequate surveys, automatic statistical data reduction, etc., grows exponentially as we move from scientific and engineering applications, to business, economical, social and psychological applications.

And the securing of proper computer-oriented information capturing networks and artifices, depends largely in the existence of sizable numbers of researches, project leaders, managers, advanced students, etc., with a sound knowledge about data-processing equipment capabilities and techniques.

1.3.5. One of the problems in this area is, thus, to establish methods and introduce the necessary changes in programs and curricula, to expose as many students from pre-university level (that is from ages 12 or 13 to ages 17 to 19) as possible, to the potentialities of computing equipment and techniques even if not enough, or even no computers at all, are available for providing the highly desirable --

hands-on experience.

To achieve this, developing countries should resort more and more to the actual and future relatively cheap models of programmable desk calculators.

The advantages to be derived from a vigorous program along these lines are not only those represented by the dynamic pressure and intelectual unrest that these students will carry on to their future professional schools, but also because of the enormously high rate of drop-outs so characteristic of developing countries.

These numerous groups of drop-outs will easily find better rewarded and best fitted (to the impending world they will have to live in) jobs, and at the same time, will be more evolutionary factors than the groups of in-the-work trained technicians, programmers and systems analysts, so painfuly and costly trained today in the still scarce computer installations.

1.3.6. A parallel and equally urgent problem in developing countries, is the problem of adult education and training in computer technology. As natural, these problems are more acute in these countries, which for so long have been deprived of the possibilities of turning out well educated and technically equipped people.

These countries have few, or relatively few, educated people around whom the complex programs necessary for the effective and rational applications of computers to development could be built.

In order to cope with this problem, it will be necessary for these countries to modify the traditional idea of formal education finishing at the age of 20 to 24, and to organize educational and training programs for engineers, economists, sociologists, psycologists, educators, etc., to become conversant with the capabilities of computing equipment and with the possibilities they entrain for their respective fields of activities.

Great imagination should be exercised for the establishment of these programs, and there is no doubt that international organization like the United Nations could play a leading role in the promotion of the development of training material in records (similar to those quite successful for the teaching of natural languages). (1) in video-tapes, for audio-visual and

1. Note in Page 19.

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closed-circuit television teaching, by mail, etc., etc.

1.3.7. Another problem related with training and education is the difficulty of getting top-level foreign experts and professors for long enough periods for their visits to be really -- constructive and formative.

There is a little doubt about the advantages of having locally resident-professors teaching in adequately equipped and staffed centers established in developing countries, as compared with the sending of (necessarily) small numbers of students to centers established in advanced countries.

The most obvious advantage is the possibility of surrounding these experts and professors with suitable amounts of native students, versus the possibility of attrition caused by the loss of some of the under-graduate students sent to pursue graduate - studies abroad.

Another advantage is the possibility for the visiting expert to organize, in paralel with his teaching assignments, one or more, modest research and development projects through which

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(1) The Latin American Institute for information and Computing-Sciences (ILACIC), is currently developing such recorded courses in FORTRAN, COBOL, and ALGOL, to be recorded in Spanish and Portugal.

the students around him could derive additional knowledge, experience and research-and-development-oriented habits.

One more, is the opportunity they have to enter in con-- tact with the computing and data processing community at large, and the possibility of thus enlarging the scope of his technology transfering capabilities.

Another one, is the contribution that these relatively - long teaching assignments (less than 3 months are not very -- commendable) make to the very needed academic mobility (in - high learning institutions from both, the advanced and the developing countries) and to the increase of intelectual permeability of developing countries.

The most important of the potential disadvantages is the lack of explicit guides and methods about how to get prepared- for these visits. Experience has repeteadly shown that, in general, it takes from 2 to 3 months of the expert's time to get his native students and collaborators " geared-in " the subject matter and methodology he is supposed to teach. And this has - been true, even in cases where there is not a language barrier.

1.3.8. From all the " problem areas " which could be - - brought up in relation with education, the most important one- IF APPLICATIONS OF COMPUTERS TO DEVELOPMENT IS OUR CONCERN, is the lack of adequate departments and schools in which the appropiate, " mission-oriented" curriculum and syllabuses exists.

There is not doubt about how much more effective and rapid the implementation of good measures for development wouldbe in developing countries if, at the same time the " what todo " is taught and made explicit, the " how to do it " is mastered and practically tested. But unfortunately, and generally speaking again, developing countries do not have within their high-learning institutions, programs and curricula flexible -- and varied enough to produce the required " development engi-- neers ", simultaneously conversant with the disciplines and -- techniques necessary for conducting research in, and planning for, development, and with computers and their applications to social and economic development.

Even where Computing Sciences Departments have been initiated, the strongest tendency is to copy the corresponding -- programs implemented in institutions from advanced countries - which, is general, are very strong and complete, but rather -- (and it is understable) specialized and narrow.

Such types of curricula are the most advisable for these latter countries not only because they have a relatively large number of computers, but also because in them it is quite easy to integrate groups of multidisciplinary groups whenever - -

the need for planning and implementation of a complex problem (like economic and social development) is tackled. It is also advisable, because these countries have flexible educational-systems in which the students can get credits from quite a wide spectrum of interdisciplinary departments while, generally -- speaking, in developing countries the educational system are-much more " department-oriented " and inclusive, and scholar-mobility is more restricted.

1.3.9. An additional problem in the educational area is the scarcity of good electronic departments or, at least, of-good intensive and comprehensive courses on digital electronics.

As it is well known, a satisfactory and useful utilization of computers depends heavily in the availability not only of-top-notch maintenance technicians but also in the possibilities of up-grading existing equipment through inter-facing to them more modern pieces of machinery and even matching together in an interconnected system, different types and brands of electronic computing systems.

The vigorous fostering of good schools and/or intensive courses for the enablement of professionals for these tasks, is also an important problem area in the educational systems of developing countries.

As it is logical, it implies not only the problem of providing good teachers and instructors but also modern laboratory and workshop equipment and components. And even more, when establishing these nuclei, it is necessary also to keep in mind- that it is not enough for them to be capable of instilling - - good practice, as good practice alone will certainly not be -- good practice in few years time, mainly because computers themselves are in an almost explosive rate of development, but also to develop research and development capabilities in them.

1.3.10. The same consideration are true about the important field of data communications.

In this field, some of the developing countries face a - rather awkward position as they might have brand-new, modern - micro-wave and carrier communications between different cities, within their territories, while suffering out-moded and unre-- liable voice-grade networks within their urban centers.

In addition, the production of qualified engineers and - technicians in these fields leaves also much to be desired, -- mainly when the high-rate, high-reliability-needs posed by - - data communication are faced.

1.3.11. Once last important area, is the lack of scholar material, of good multi-lingual glossaries and of efficient -- and well-organized information and documentation centers.

1.3.12. References will be made, at this stage, to Mobile Computer Centers and to some experiences gotten from them.

a. As it is known, for several years a " mobile computer center " was utilized by the author in Mexico as an educational device with the purpose of creating, at provincial universities, groups of local people interested in pursuing the development of computing activities at their respective localities. The aim was, in short, to create, *innovation triggering* groups " through " coupling " between experts from the parent Computing Center and the local groups.

A small digital computer and portable analog computer were mounted in a truck, and an extensive program was implemented, teaching to professors, to undergraduate advanced students and to selected persons from the local governmental agencies, industries, commercial and service enterprises, etc.

b. The intensive training and the hand-on experience given during the two-weeks intensive courses met, without exception, with an enthusiastic response. The spectrum of problems of real, immediate interest proposed by attendants was almost always larger and more intelectually simulating than that usually found in the conventional courses taught regularly at the university where the medium and large-scale computers were installed.

The experiences derived seem to demonstrate that once the interest was aroused (in general through trips made by persons two to three weeks before the arrival of the " mobile computer center ") the attendants usually displayed more ingenuity and demonstrated more interest and responsibility than in those cases where the students felt that the computer gear was permanently established and within the " reach of their hands ".

It was also consistently observed that the rate at -- which the -more hetereogenous- groups of students learnt, - was higher than in the conventional courses held at the permanent computers center. One reason for this, was probably- that professors and students were mixed and taught together, with emulation strong among them.

Two added factors seemed to be also important for - - reaching these results: The first one, was the special psycological atmosphere created by the certainty about the - - " loosing " of the computer after a two to three weeks period. The second one, seemed to be both, the better conditions under which the instructors sent along with the equipments used to works,(as the detachment of their usually heavy schedule back at home gave them ample time to give personal -- attention to relatively high numbers of students attending the mobile courses), and the fact of having the traveling computers exclusively devoted to the course, without any other - commitment or processes going on concurrently.

c. The main disadvantages encountered were the following: The first, was the dwindling away of the interest and the enthusiasm, once the Mobile Computing Center moved to its next scheduled assignment. The second, was the " internal - - brain drain " provoked by the moving of the best of the students from the mobile courses, to the parent Computing Center and their final settling down in the main city, in spite of - the varied methods put in practice to encourage them to go -- back to the cities and universities they were originally working for.

As an incentive for keeping up the interest of the- trained groups, free-time in the medium and large-scale com-- puters installed at the parent computing center was offered.- This imposed the necessity of giving training in more than -- one computer and of establishing an assortment of communica-- tion channels.

The experiences derived during these years proved - how difficult would be to developing countries to establish - remote-access terminals linked to a central computer. In general the communications networks in these countries are - paradoxically - very old, and the state of conservation is poor.

This is generally explained by political and economic reasons, as the (usually foreign) companies which have hold the concessions for these public services are reluctant to make the large investments necessary to modernize the networks and, at the same tiem, to cope with the investments required by the extensions called for by the increasing demand, fearing the understable popular pressures for the transfering of ownership of public services to state-controlled companies.

Further investigation, pointed out the fact that the situation tends to be even worse for in-the-city networks (voice-grade networks) as they tend to be even less modern than carrier or microwave links recently established between cities.

d. The usefulness of Mobile Computer Centers for the creation of " technology poles " which could become active factors in the development of computer and data processing sciences, depends on several factors.

i. The first of them is that the geographical and organizational structure of the developing country should lend itself to the use of such a technique. In the case of Mexico, when the Mobile Computer Center was launched, only the two largest high-learning institutions had computing centers, and both of them are located at the capital of the country. in the rest of the 39 universities and high-learning institutes of this country, every degree of awareness about computers and their applications could be found. Six years after the Mobile Courses were launched, five more of the universities - - have installed computers.

The most important ones among these institutions were the ones selected for the periodic visits of the Mobile Computer Center. All of them are connected with the capital city by good highways and by telephonic lines. Two of them were- connected also via carrier channels.

ii. The second factor is to have the possibility and- financial resources to equip the truck, a portable digital- computer to mount on it and the capability to cover the - - operating costs.

iii. The third factor -and probably the most critical one - is to have a minimum of available experienced instructors, professors and maintenance technicians. And in addi-- tion, it should be possible to be in a position to spare -- enough of their time, not only for the travels themselves - but also for the preparation of the teaching materials of - the exercises, etc., etc.

iv. A fourth factor, is to have a large-scale additional computer which could support the activities of the different trained groups, once the mobile computer moves to another city.

v. One additional factor, is to be able to devise an effective way of discouraging the permanent migration of - the best of the provincial students towards the parent computer center. And of giving them continued technical and - scientific support until it becomes possible for the local group to install their own computer.

The parent computing center can help the local groups in this last respect, by allowing them free time in his -- large scale computer (which they could charge for) to -- their local customers. In some instances, and when the local group has become technically strong, they succeed in - building a host of users that could eventually support -- their own installation, leaving ample time for the scientific and technical activities of the promoting groups.

e. If mobile computer centers are to be used for the specific purpose of fostering the application of computers system to economic and social development, it would be necessary to put special emphasis not only in the proper integration of the local groups (which will have to include economists, sociologists, applied mathematicians, etc.)- but also in reinforcing and enlarging the teaching groups and the materials which should be taught.

g. In addition, the purpose should be also more encompassing, as it will have to have as an objective the creation of a group working in the intersection of both -

areas, computer science and technology and planning and managing of development.

If possible, the efforts should simultaneously -- strive for obtaining the implementation of suitable curricula at the local high-learning institution, for a more regular and professional production of well-trained computer- - oriented specialists in development science and engineering.

h. A last remark seems to be pertinent, and that-is, to point out that the concept of " mobile computer centers " can be extended and modified to " mobile " national- and international groups carefully integrated experts, by - professors and by advanced students from advanced and developing countries, which could visit reputable and solid computing centers established in developing countries (if, naturally, they are interested in promoting the applications- of computers to economic and social development)for periods of 3 to 6 months and with the specific purpose of developing the necessary hybrid groups.Not all the members of the " mobile " groups have to be simultaneously in the recipient -- center, as they could be conveniently spread in time, to cover a carefully drawn program.

This possibility will be taken over again in the- second part of this paper, where some suggestions about the possible role of the United Nations in this field are pre-- sented. It is sufficient, now, to mention at this stage that a proper and careful previous preparation for these type of intensive and multidisciplinary " mobile " sets of courses would be much more necessary than in the case of the visit of one single expert.

The recipient computing center will have to be prepared to assemble the indispensable group, pooling together all and every one of the necessary talents, experiences and backgrounds. This is not an easy task, even in capital cities of developing countries; it is even more difficult, at provincial cities from these countries.

1.3.13. Another problem area in developing countries, is the difficulty to divert undergraduate advanced students from engineering, chemistry, physics, mathematics, economics, sociology, etc., to new fields as in the case of Computing Sciences.

This problem, originated in the relatively rigid structure of curricula and in the lack of interdepartamental academic mobility, makes it difficult to convince advanced students which have taken 5, 6 or 7 semesters of engineering, of economic or of any other conventional curriculum, to go abroad to pursue graduate students in Computing Sciences.

The most common pattern then, is to find these students interested in learning about computers and their applications to their particular field of interest, but not in changing over completely to computing and data processing sciences.

If more flexibility would be allowed in getting credits in a multidisciplinary way, and if professional (flexible) careers in Computing Sciences were to be established in universities from developing countries, these drawbacks could be alleviated and the indispensable groups, professionally devoted to computing and data-processing sciences, will be formed in a relatively short time.

1.3.14. Parallel programs for the training of competent auxiliary technical and administrative personnel which up to date are extremely scarce, forcing senior experts to waste their time in the performance of tasks usually confided to skilled personnel.

1.3.15.The solution of many of the preceding problems related to education will make it necessary to change the typical working conditions in high-learning institutions of developing countries.

It will be necessary to modify the common pattern of a set of disjoint schools and departments, with faculties integrated by poorly paid professors which only spend a small fraction of time, barely enough for teaching their classes to overpopulated (80 to 120 students classroom are not quite an exception).

The archaic structure, within which the teaching of basic subjects is not centralized but atomized and multiplied throughout almost every one of the departments and schools, must leave its place to a more rational organization.

Self-containtement and imperviousness to communications with others, will have to be abolished. The proliferation of underfinanced departments and the useless multiplication of labor and expenses will have to be changed-by a true university reform.

And computing activities, because of the interdisciplinarity of its very nature, will be a strong factor -- (if properly managed and directed) in helping these re-- forms to come to fruction.

1.4. Problem areas. (Financial aspects).

1.4.1. The installation and utilization of -- computers is an activity that has many of the characteristics of " big science " and many oftenly found in medium - and small-scale scientific and technological activities.

As it is well known, it requires a relatively high initial investment not only for the acquisition of the equipments but also for the costs involved in the physical installation and in the training of all the necessary personnel.

On the other hand, once these first stages are surpassed, the explotation of the facilities and the scientific and technical production derived from them, depends almost -- completely on mental power and the only limit it has is the - ingenuity and the capabilities of the personnel around them.

1.4.2. In spite of this, and speaking in general,-- it could be found that governments from developing countries rarely have a clearly defined policy to support the acquisition of computer gear and for subsidizing the associated costs.

The main characteristic of resources allocated to - the acquisition, installation, operation and up-grading of -- computer installations, are their insufficiency and their lack of regularity and stability.

There are instances, of the most costly computer -- systems been supplied by governments, because of convincement, of circumstancial relations of computer experts with governmental officials or, simply because of reasons of prestige. - But almost always, funds for operating costs and maintenance expenses, have been much harder to obtain.

It is equally hard to get further funds for purchasing peripheral equipment or routine supplies for the upkeep - of the computing gear.

Progress has been made in some of the developing countries in this respect and when this have been done the results have been gratifying. In these cases, the collaboration of local and foreign experts with governmental officials, has resulted not only in sensible selections of digital electronic equipment but also in the integration of relatively powerful-centers with the concomitant higher rate of useful utilization and production.

An added advantage of making governments aware and-respectful of the potentialities of computers and their applications, and of securing their financial support for their --purchase and installation, is their early interest in taking-advantage of the investments they have made for the processing of governmental administrative and technical problems.

1.4.3. Even less clear-cut policies can be found --about the financial support to the three most important practical applications of computers: automation, data communica--tions and automated Information and Documentation centers.

The most frequent attitude towards automation (and in this case automation is taken in its widest sense, comprising from administrative processes automation, to automatic -control of static and dynamic, mechanisms from continous to-discrete processes and equipments) is the superficial rejection based in the, valid to certain extent, fear of provoking massive underemployment.

The maintenance of this rejective attitute through long periods of time, will undoubtedly have disastrous effects in the whole of the economic and social development process, - as the productivity of these countries will forcibly be more - and more low and their competitive status in industrial and -- services production will continously deteriorate vis a vis the advanced countries.

Up to now, little has been done in the field of research- and study of " degrees of automation " commendable for developing countries. Because of this, it is not surprising to find - out developing countries which, as an example, are heavily dependent on the explotation of mineral ores and that precariously maintain certain degree of competitiveness through maintaining extremely low levels of salaries. With proper guidance and sufficient technical and scientific advise, these countries -- could implement adequate " degrees of automation " in their -- mining activities which could greatly increase the productivity and/or the absolute volume of production, with a corresponding elevation in the standards of living.

There is a little doubt about the urgent necessity - of communicating the potential value of these applications to- today's government decision makers. But as natural, an added - difficulty is that automation requires electrification and this is frequently one of the largest problems in developing countries.

1.4.4. The second of these problem areas, that is, the one related to data communication, is closely tied with the problems posed by the state of communications networks which have received attention in previous paragraphs.

As evident, this represents one of the crucial contradiction between the needs and the means of developing countries. - While everything seems to point out the advantages which they - could derive from utilizing central large scale computing systems and remotely located terminals with adequate input-output-terminals (for real-time processing and proper use of multiprogramming capabilities), the real possibilities offered by the existing communications networks are relatively poor.

1.4.5. A similar situation exists, in the large majority - of developing countries, in the field of automation of scientific and technical documentation centers.

As it is well known, in some of these countries and mainly because of UNESCO's decisive efforts and continued assistance, - good Documentation and Information Centers are functioning (or have functioned as, in very painful cases, they have been or -- destroyed, or left exposed to processes of financial starvation).

But even in those cases where these mostly needed centers have survived, little has been done to convert them in advanced centers for the utilization of computer technology in the varied operations which could be advantageously automated.

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As it is well known, it is of the greatest importance that computer scientists and professionals who work in developing countries have as much contact as possible with - the works developed by scientists abroad. This allows them not only to endure the poverty of their local scientific - milieu but also to keep abreast of latest developments in- all aspects of computing science and technology.

But generally speaking, governments are not aware of- the benefits derived from such a familiarity with current- published material nor, consequently, they have well defined policies to gather, sistematize and disseminate scientific and technical information be it related to computers or related to any other field of human knowledge. In the - majority of developing countries scientific and technical- libraries, the collections of periodicals show wide gaps - that reflect the periodical absence of available funds.

1.4.6. Another of the problems related with the scarcity of adequate financial support is the problem of international exchange of experts, professors and advanced students to and from economically advanced countries and - -- among the developing countries themselves.

Their problem have several aspects and the main ones- will be dealt with in the following order:

i. Research and teaching appointements.

ii. Sabbatical leaves and joint appointments.

iii. Post-doctoral fellowships.

iv. Scholarships for graduate students.

v. Support of supra-national research and development projects which could be simultaneously utilized to give in-depth training in specific subjects.

Each one of these items would justify a several-pages study by itself. The scope of this paper imposes limitations in the number and extension for the comments. The most important ones are, to the best of the knowledge of the author, the following:

i. Research and teaching appointments.

Foreign scientists and experts from advanced countries have played an important role in the implantation and progress of research and development groups in developing -- countries. As it has been pointed out before, such contributions, require long stay which must enjoy favorable conditions.

Experience has shown that short visits benefit only mature scientists and thoroughly experienced experts, but -- they usually do not result in an effective training of new - ones.

Unfortunately, there are many factors which prevent those long stays to take place. The most important are: the lack of funds to establish attractive offers to foreign professors; the lack of encouragement and seniority recognition given by the universities they pertain to for these appointments; the incredible amount of difficulties from the part -

of institutions from developing countries to allow foreign professors and experts to occupy permanent positions; some even more incredible restrictions in salaries, which make it very hard to hire them unless they are paid by anyone of the international organizations. It is not infrecuent, in addition, to find that administrators and responsible government officials show such a lack of support and such an unsympathetic behavior, that they discourage the enthusiastic inclination from many foreign computer experts to actively cooperate in helping the developing countries.

ii. Sabbatical leaves and joint appointments

Among the possible programs which could be launched under the sponsorship of the United Nations, one of the most promising is to build-up and keep a dynamic register of every scientistic and expert in computing sciences and technologies and in their applications to the planning, the implementation and the evaluation of economic and social development programs and the dates and periods in which they are entitled to, or are intending to have, sabbatical leaves.

Having a corresponding catalogue of needs and opportunities opened by interested institutions from developing countries, the available scientists and experts could be informed about countries, projects and conditions among which they might find it advisable to spend their sabbatical leaves.

As natural, those openings should constitute attractive offers if they are going to be competitive in attracting the high-level scientists and professors. And the conditions which make an offer of this nature attractive include not only an adequate economic compensation, but also the availability of good equipment, of a number of knowledgable, fairly advance students, the existance of stable and permanent positions and favorable inconvenient, the security of obtaining confortable and adequate living quarters for them and their families, etc., etc.

And for securing all these conditions, it is necessary to overcome all the difficulties described in the preceding paragraph.

Even more difficult to solve, are the problems posed by " joint appointments " under which scientists, professors and/or experts from institutions pertaining to both, advanced and developing countries, are enabled to spend a few months in each others institutions each year.

In addition to all the problems already mentioned as affecting computer and development experts from advanced countries, there are those affecting their counterparts from developing countries.

As it is well known, scientists, professors and experts working in these latter countries have to hold more than one job to earn a living. Truly full-time positions are scarce, and delays of weeks and even months in making salary payments, high rates of inflation, cuats in budgets allocated to research and development projects, salary freezes and the possibility of losing the support of all powerful cliques that sometimes hold the decision and administrative power, make it very difficult for them to have any confidence in " full-time"-positions.

This condition tend to make it almost impossible for many of these persons to take advantage of fellowships and grants to travel abroad. A situation that is further worsened by the meagerness of locally allocated funds for these purposes and even for the participation in seminars, workshops or meetings organized in the home country or abroad.

iii. Post-doctoral fellowships.

Almost every one of the financial difficulties described in the previous paragraphs, are valid for explaining the hampering of liberal policies concerning fellowships granted to individuals which having obtained master and doctor's degrees in foreign univiersities, to work in developed countries in advance research and development projects related to applications of computers to economic, social and cultural development.

The scarcity of funds, the financial personal problems of the native experts and in many cases, the specter of the brain-drain (which to a large extend also has a financial basis, as it is caused not only by the better economic position offered to scientists from developing countries, but also by the possibilities of having access to larger and more sophistically computing systems, to specialized new equipment and to a richer wealth of latest information) often tends to produce a policy of closed doors, which does not allow nor young people to get their graduate training abroad, nor young experts the opportunity to work on his own in novel applications of computers and gain confidence in himself.

It would be necessary, in order to promote applications. of computer sciences and technology to development, to organize a suitably financed program to overcome all of these problems. These funds should be readily accessible, should cover a wide spectrum of potential proposals and should allow for a diversity of activities from the part of individual applicants.

At the same time, if it is not to be met with ill-will and resistance from the part of many of the developing countries, should involve a certain degree of security about the returning of the applicant to his home country.

iv. Scholarships for graduate students:

Again, almost all of the previously discussed finan cial problems, are pertinent in the case of programs for graduate students development through scholarships to pursue graduate works at home and/or at advanced countries.

One added problem, not exactly within the scope of financial ones, is the erroneous policy pursued, in general, regarding the search of suitable candidates to fill all available openings offered by foreign governments, international bodies and local patrons or incipient governmental and private foundations.

This policy,.that is one of the reasons why less than 40% of the available scholarships are utilized in developing countries, is the policy of limiting the searching action to the affixing of posters, inserting small notes in the local newspapers and/or passing short radio and T.V. spots about them.

A sensible policy should call for an active and aggressive " scouting " policy through which an active inspection and supervision of good and promising students would be kept at least along the two last years (or the 3 to 4 last semesters) of every one of the professional careers.

The final aim would be to ensure that every interested and deserving student would come out from the professional school (bachelor's degree) knowing where he is going, with whom he will be working, which language should he master, under which conditions will he be traveling and staying abroad for a period of 3 to 5 years and where and how would he be coming back if he succeeds.

Without this long-range planning, the students would continue to be frustrated fighting against the thick jungle of - - bureaucratic procedures; of last-minute language profficiency - examinations; of applications and granting of visas, permits, - paper validations, etc., arrangements, etc., etc.

v. Support of supra-national projects

The organization of this kind of projects, which would be a sort of high-level, specialized and in-depth workshops - - would serve many purposes. Among others, probably the most im-- portant would be to give the opportunity of giving groups of experts from developing countries to concentrate efforts in the - identification and study of common problems and general characteristics of underdevelopment and about the programs to overcome it.

In spite of its potential value, very little financial- support is generally allocated from the part of the corresponding governments, probably because of the lack of confidence in- the results coming out from efforts of joint groups of experts- or technicians coming from countries comparable in status, to - their own one.

This attitude and lack of interest and, as a result, of - the indispensable funds, is a major factor in explaining not only the relatively small progress in regional studies and the almost nihil cooperation (at the supra-national level) for the- application of computer to integrated (regional) development-but also the fact that the best and better documented studies about underdevelopment and possibilities of development in almost all of these areas around the world, have been written - and published by scientists and experts from advanced countries.

1.4.7. Summing up, it can be said that a solid progress of computer applications to every aspect of social, economic- and cultural development depends heavily, in developing countries, not only in the appropiation of the minimum of financial resources indispensable to buy, rent or lease the necessary equipment, not only in the funding of the installation -- and operating costs, not only in the granting of enough fellowships and shcolarships but, to a large extent, in the establishment of continued and stable-in-the-long-term economic and financial conditions for both, the computer installations involved and the individual scientists, experts and technicians -- without whom those installations are almost useless.

1.4.8. Some consideration will be given to the financial aspects of the activities of manufacturers in developing countries. While undoubtedly their usually vigorous sales activities constitute effective ways of disseminating awareness about computers and their applicationsit, it is also true that in developing countries their attitude toward the development of -- computer related research and development tends to be rahter superficial.

While manufacturers become important factors in giving the initial impulse to training and education, they also can act as deterrements of the convenient coordination of all computer-oriented people and of all the computer installations because of their sales practices and the projection of their particular interests and rivalries upon the personnel of the different computing centers.

With very few exceptions, it is almost impossible to find out programs of financial support of research and development centers (even if entirely dedicated to the field of computer applications) comparable to those supported by the manufacturers in their home countries.

Even in those cases where support for studies abroad has been given to deserving students, the main purpose has been to strenghten their sales force more than to foster the advancement of computer applications.

In the majority of cases when computing equipment has been donated, it has been because private foundations have covered to them their cost.

But there are reasons to believe that in the near future, manufacturers will be more sympathetic to cooperate with programs sponsored by international organizations, because the announced " unbundling " of their services (separation of monthly rentals, of charges for education and technical assistance and of cost of maintenance) will increase the costs of installation and consequently, at least in developing countries, this will probably tend to reduce the already meager markets. Well coordinated plans involving manufacturers contributions could help in alleviating these costs, mainly in the training and education and in software implementation and development.

This last area is a rather important one, not only because of the conditions described when " hard-software " problem were discussed, but also because many of the " packages " and " problem-oriented canned routines " (like " payroll ", " inventory control ", etc.) are seldom usable without extensive adaptions, which is also one of the important difficulties that developing countries experiment for taking proper advantage of the growing number of software packages ava[illegible]le from specialized enterprises of advanced countries.

1.5. Problem Areas. (Assessment and decisional)

1.5.1. The problems posed by the evaluation of computer systems and by the decision to purchase, lease or rent the most adequate of these systems, are rather difficult in developing countries.

As natural, the main problem is the lack of truly, experienced experts in the varied aspects which have to be considered when assesing and deciding about one among the host of computer systems. These problems (which also exist in economica lly advanced countries), are more critical in developing countries because in them it is almost impossible to assemble -- groups of experts in hardware, in software and in communications (if modern third generation systems are considered).

1.5.2. The end result of this situation is that the -- real factors in the adoption of these decisions, are the salesmen of the local agencies of the manufacturers whom (even when, as it is true in many cases, try their best in favor - of the potential customer) usually have also very limited - experience and have been exposed only to biased and incomplete information. Moreover, salesmen are trained by their employers in sales techniques and never in the three or four - quasi-formal techniques which have been slowly arising for - the establishment of objective and unbiased comparisons of - computer systems.

To make things worse and as can be easily constatated, in many of the developing countries only one, or very few of the the manufacturers, offer their products.

Information about the rest of the manufacturers, and - about different types of computing systems, is almost inexistent; and when known, it is restricted to a handful of dispersed individuals which have been in foreign advanced countries, have attended international or national meetings at -

developed countries and/or have kept themselves aware of new developments through systematic study of specialized periodical publications.

1.5.3. The utilization of foreign experts as decision-factors, or as complement of local groups of experts, has -- been slowly increasing. Nevertheless, it has not became a -- common practice because, as it has repeatedely been realized, a foreign expert is logically restricted to base his analysis and adopt his decision strictly on the evaluation of the characteristics, prices and qualities predicated on the diffe-- rent pieces of equipment and their corresponding software, - but being severely limited in the possibilities of taking into account the characteristics and peculiarities of the jobs and applications the system is meant for, the experience and background of the personnel it will be surrounded with and - the real support and service that the user can expect to receive from the manufacturers.

1.5.4. This is clearly an area in which international-bodies and associations can help developing countries.

Up to now, IFIP has played an important role-even if - indirect - in this area. Its contribution has been indirect, because it has been centered mainly in four activities:

a. The organization of the International IFIP Congresses.

b. The organization of the six-months long In ternational Seminars on Automatic Data Processing.

c. The fostering of the creation of National Computing and Data Processing professional societies.

d. The publication of several proceedings of specialized international seminars and meetings, gathered around specific important topics of the computer and data processing sciences.

There is a little doubt about the very important contribution which any of the international bodies or organizations could play, if they organize groups of experts and technicians (with solid " curricula-vitae " and with experiences about countries, about conditions and in applications, similar to those the applicant developing country is facing), in order to give them proper advise and train their personnel in available techniques for the analysis and evaluation of computing systems.

This last condition (the necessity to provide advisors, with experiences gained in countries and conditions as close as possible to those to be worked on), becomes even more important if applications of computers to economic and social developments is to be considered, as this is a case in which the evaluated computer systems should be considered against vastly different needs (if development of advanced

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countries is compared with the varied gamma of problems - - which developing countries face).

1.5.5. Another way of helping these purposes, would- be to organize an Information Unit which could provide adequate written information, in the necessary languages, for- giving the local responsible people the best known-to-date- techniques for the adoption of these decisions.

1.5.6. A natural development of these ideas, would - be for such an information Unit, to extend its action into- the research and investigation about the best of the methodologies extending it in scope (as compared with the existing ones) to cover " performance against needed jobs " by- second versus third generation systems and, in the years to come, by " n-m " generation system versus the " n " (last) generation, as it will be likely to be a great advantage in prices and conditions when " dernier cri de la mode " equipment is not utilized.

1.6. Problem areas. (Installation and operation).

1.6.1. As it has been pointed out previously,- these are tasks which, despite the more or less formalized- approach the manufacturers have utilized, represent quite a problem in many of the developing countries.

In general the provision of adequate environ-- mental characteristics for computing systems turns out to -

be not an easy problem. In particular the air conditioning systems design and installation is put in the hands of enterprises which at most, have experience in office buildings and in homes air conditioning. Their usual task has always been to install off-the-shelf small equipments usually design on the basis of " latent heat " and not, as it should be in the case of computer room installations, on the basis of " sensible heat ".

Another drawback is that the technicians utilize -- tables, graphs and curves usually designed for sea-level - conditions, without making the necessary corrections in the computing of BTU's dissipated nor in the needed capacity of locally fabricated ducts, to be compatible with foreign -- made compressors, fans, etc.

It is not unfrequent that the end result is to have installations not working for periods as long as 5 or 6 - months; to induce damages in some pieces of the equipment- and to spread around the notion that a computer installation is something of extreme difficulty even before it comes to the utilization of the computing systems.

1.6.2. Problems of similar nature are encountered - in the area of the provision of electrical power.

In many of the developing countries, the power distribution networks are outmoded and very old. In many cases these public services have been for years (or still -

are) concessions held by private companies which have not considered to be in the best of their interests to modernize and update the installed distribution networks and, at the same time, to make the investments necessary to keep up with the increase in the demand.

In addition, many of these networks have been set up for frequencies different to those for which the computing systems have been designed, making it necessary for some of the users to buy, or to build locally, frequency converters equipped with costly voltage regulation devices.

The frequent failures in providing power (1 or 2 failures per day would not be too much of a surprise) and in providing stable power which does not beyond all permissible limits sat up by the manufacturers, has began to influence the programming techniques and the way operating systems of the third-generation systems are used.

It is not uncommon to find out that, in several of the developing countries, it is not easy to find the expertise for the proper solution of these rather specialized installation problem.

1.6.3. Among the installation problems, it is logical to consider the physical testing and the ".mise au point " of the most important items of the software, namely, monitors, -

executive routines or operating systems, compiler translators, the set of the mathematical and statistical routines, etc., - etc.

As it is well known, this has always represented a tough problem because of the very poor documentation provided and because, in general, the system and sales personnel of the manufacturers do have even less practical experience in these items and chores, than the user's personnel.

And as natural, in these countries it is not possible to rally experienced technicians from some other installation as is the case in economically advanced countries where hundreds, and even thousands, of computers are installed.

Because of this, it is not unlikely to find many of the computer installations still programming in assembling languages, after many frustrating attempts to make compilers translators to work.

1.6.4. User's groups are of very little assistance in these problems, because they are, or non existant, or very small gatherings of 5 or 6 users of comparable models.

And this is another worthwhile contribution which international bodies or professional societies could make in these countries, fostering the integration of Computer User's Groups, instead of model or brand users associations (as there are many cases in which there is only one user of a cer tain model or brand of computer).

1.7. Problem areas. (Up-grading, betterment and change-over of computing gear).

1.7.1. These are very tough problems, with many facets and about which it is quite difficult to establish clear-cut, general policies. The up-grading of existing equipment - - (at least from second-generation, transistorized machines on) seems to be one of the possible approaches developing countries could follow. As it is natural, for economically advanced countries there are even advantages in completely changing over - - their computing systems after 3 or 4 years of utilization. Or - at least, when third-generation " compatible " machines from families or series of models are concerned, to shift to one of -- the models of the upper brackets.

On the contrary, in developing countries this might not be an advisable trend (even if up to now it is the dominant trend because the bare reality is that the real decisive - factor in deciding a changeover from one model to any other, or from one brand to another, is the aggressiveness and salesmanship of the manufacturers personnel) because the amortization-period for the total investment (purchase or rentals, local -- conditioning, training of personnel, software and specific programs development, etc., etc.) is necessarily larger than in the former countries. And this is true in both, real financial terms and in " social cost ".

Even a superficial analysis of the pertinent legislation in developing countries will show that the most common trait is to assign a 10-years period of amortization to this equipments.

On the other hand, there is a real danger for developing countries of falling back even more dramatically in technological and scientific progress, as their equipment grows older and older and, what is worse, more and more isolated because of the sharply diminishing number of machines of those models installed all over the world.

This danger would be less acute if the following conditions could be fulfilled:

1.- If developing countries keep a substantial number of these " prior to the last " generation machines in operation.

2.- If effective international networks of users of these machines could be set up, and the indispensable active interelationships and exchange among the members of such networks can be established and maintained.

3.- If enough expertise and technical advise can be given, or developed locally, to design and manufacture the necessary interfaces to eventually covert single-computer ins tallation, in well balanced, powerful multicomputer installations, capable of serving (if necessary) collections of on-line remote terminals.

1.7.2. As it is well known, large-scale second-generation computers (7090, 7094, 1604, 501, 601, PDP1, etc.) can be converted not only in " on-line terminals ; serving computers " but even, if it becomes convenient or useful, in time-sharing systems. These conversions are greatly facilitated if small computers with interrupt facilities could be interconnected with the large scale ones, acting as message switching devices, and/or if massive random-access storages (disks, -- drums, etc.) can be interfaced with the small or the large - computers.

1.7.3. If this is done, the cost of a powerful installation can be at least an order of magnitude lower than if it is decided to go directly to one of the third-generation systems, mainly because the computers can be purchased in 10% to 30% of their original cost, which is at most, 30% to 40% of - the cost of an equivalent third-generation system. With the - added advantages of having faster central processor units, as they usually are fixed-word, built-in-parallel computers, The cost of reprogramming and building of the software will also- be lower.

1.7.4. As a counterpart, the most likely problems the users would probably face, is the growing scarcity of certain number of the components employed, and an also growing reluctance from the part of the manufacturers to take over the -- maintenance of the (most likely by them multi-brand) computer systems.

The first of these disadvantages is a relatively - -- tough one, if it is considered that the relatively few transistor factories established in developing countries are - - mainly producing audio components and very few produce power transistors. The same situation exists in relation to diodes, capacitors and even resistors as the quality leaves much to- be desired and 5% tolerance quality is not even fabricated in many of these countries.

Nevertheless, a well thought program, supported by -- the prestige of an international body as the United Nations- and maintained under their sponsorship and control through a small Executive group appointed (and with their full backing) by the U.N., has very great possibilities of securing the manufacturers support in components and spare-parts, for a period of 5 to 10 years.

The second of the disadvantages in less serious, as - it has been proven that developing countries are perfectly -

capable, if the proper educational and training assitance is given, to integrate excellent and reliable groups of maintenance technicians.

1.7.5. The cost advantages of these approaches should be, anyway, carefully evaluated vis a vis the possibility of a lowering in the cost of certain parts of the hardware and the certainty of an increase in the total cost of the operation of a computing system. (as an effect of the " unbundling " policy followed by the manufacturers).

1.7.6. Up to now, reference has been made to up-grading and betterment of existing installations and about the integration of new " cheap " installations.

But as natural, there will be many cases in which changeover to sophisticated third generation systems has been already made, or would be advisable.

In these cases, what has been said about assesment and decisions is completely valid.

1.8. Problem areas (Software accuisition and consulting services).

1.8.1. These are problems which are, again generally speaking, beginning in developing countries. As it is natural, the software up to now provided by the manufacturers is not included in this category, It is mainly-the commercially developed and marketed software, and similar consulting services, which will be considered.

1.8.2. As it is well known, it has been predicted that the most recent trends followed by the manufacturers which have chosen to separate (cost-wise) the provision of hardware, software, and probably training, will cause an unprecedent flourishing in the market for software, specialized packages, custom-made programs, and consulting and training services.

As usual, there will be a parallel development of high-quality, serious groups and, simultaneously, of self-declared experts which have nor the talent nor the experience to really contribute something worthwhile to their unfortunate customers.

In developing countries, both developments will take place in the midst of a fierce struggle against local agencies of scientifically and financially powerful software and consulting enterprises from foreign advanced countries. These agencies could have a substantial success in the development of specialized software and of custom-made programs, but very little in the transplanting of " packages " developed in their home offices, as past experiences had shown that the peculiarities of organizations from developing countries are important enough to prevent a successful direct trasplanting of these packages.

1.8.3. The final result of all these considerations will be, very likely, an increase in the total operating costs of computing equipments in developing countries.

There is not any reason to hope that the apotegm valid for the acquisition of capital and durable consumer - goods equipments, will not be true also in this: As it is - known, a large percentage of these equipments cost 10%, 15% and even more than their original cost in the advanced countries where they are fabricated. And there is every reason to believe that this will be the case with foreign software developments and consulting services.

This will be partially balanced by the highest - quality and more extensive experience that supposedely will back-up those services.

1.8.4. As it is evident, this will be a very - - fruitful and worthwhile field for an action from international bodies, not only helping and assisting in the development of high-quality local groups, but also for the integration of non-profit multi-nation groups of experts integrated on a voluntary basis, which could offer consulting and software development services on a conditional basis: that each one of the projects they would be serving in, should - simultaneously serve two purposes: as intensive high-level -

mission-oriented research project,and as an educational tool for the training of carefully selected local experts.

1.8.5. Another activity in this same direction -- will be for a United Nations sponsored group to create a - - Software Library in which the collection of programs, translators, operating systems, etc., etc., from every country -- (if they have been properly debugged and documented) and - for every brand of computer, for their provision to the interested users a a nominal cost established to cover the operating costs of the group and the cost of a regular loose- - leaf secondary publication in which information about the actual content of the Library, would be disseminated.

A relatively easy way to integrate such a library would be to ask from every member state to state to every - one of the manufacturers and software development enterprises wishing to market their services within their territory to deposit one properly documented copy of the products - - they intend to market, in a National Repository affiliated to the Software Library Group.

The commercial status of those enterprises will- be only slightly impaired, as any user obtaining the products from the Software Library will do so at his own risk and most probably would still be interested in contracting the originator for its implementation.

As logical, only reputable and eligible users would be allowed to draw from the International Software Library and - even then, after giving proper assurances about the use they- will make of the product, mainly when copyrights are attached to these products.

1.9. Problem areas. (Financial and Social implications)

1.9.1. Many of the financial problem associated - with applications of computer technology sciences to development, have already been dealt with, or will be dealt with in- the rest of this paper.

Nevertheless, one suggestion might be opportune at this stage. The suggestion would be for the United Nations to- sponsor the integration of a Common Fund from which develop-- ing countries could get long-term loans for the acquisition - of computing equipment and the installation-at-large[1], of - computing centers whose main activity would be connected with the supporting and data processing of tasks directly related- with economic and social development.

The paying back of these loans could be, up to certain percentage of the lent quantity, through the provision of - -

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[1] Id est, the installation comprising air conditioning, power provision, etc.,

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experts, advisors or teachers, in fields where they might have qualified personnel and experience and related with the same purposes.

As an example, if a developing country borrows Dls. 100,000.00 from the Common Fund, it will have the right to refund up to Dls. 40,000.00, providing experts, professors and advisors which the Fund could utilize in other developing countries.

(This was a concept which worked nicely at national level, for a short period, as an extension of the Mobile Computing Center organized by the author in Mexico).

1.9.2. An extensive treatment of the social implications which the intensive use of computers in all sorts of applications, and in special for economic and social development, will require a paper larger than the present one.

Emphasis will be made, anyhow, in some of the more important points:

a. Computers rank among the best of the " technology-transferring " devices.

b. They are also one of the best means for " coupling " for innovation.

c. They will have a tremendous impact in the revolution of the educational structure of developing countries. This revolution will be more dramatic and multifacetic than in advanced countries.

d. The big problem of " who will command " the power of the computers, will also have a richer and more varied impact and social connotations in developing countries.

e. They will cause unemployment, but in different social strata than in the advanced countries.

f. They will have a tremendous effect in the reexamination of current socio-economic theories, by the bare fact of their dissemination and multiplication.

Once the main social problem begin to be the organization of the leisure time of human beings, and not the organization of working time of human beings, current " isms " would experience also a profund revision.

g. Computing, and its three main practical applications: automation, information management and retrieval, and data communications will have intermingling effects. Each one of them deserves a complete study by itself.

h. Automation in particular, poses extremely interesting and challenging scientific, technical, financial social, economic, psychological, behavioral and academic problems to developing countries. If social and economic development is our concern, this is probably one of the most (if not the most) important aspect of the utilization of computers for these purposes.

i. The intensive and extensive utilization of computers at universities, high-learning institutions and research centers, both in natural and in social sciencies, is already changing the creative habits of scientists and researches from developing countries.

Before the computer appears, the monographic, descriptive and overloaded with " erudition ", type of research, is the most common and favored.

After some years of exposition to computer technology, a substantial change takes place and the more incisive, quantitative and objective type or research (and researches) begin to appear.

This, and similar changes in patterns of behavior in many of the social strata and groups, are not only triggered but vigorously pushed forward by the mere utilization of computing technology.

j. And this is one example of how much computing systems and their applications can contribute to development - - through their powerful impact in changing attitudes and mental patterns among their users. Expansion is then, naturally complemented, and the cycle of development by human beings can be completed with its natural second part, development for human-beings.

2.0. A scheme for international action

2.1. Computer installations, when properly managed, count among the most powerful " technique transfering " devices.

" Technique ", in this context, would be any set of procedures for the material transformation of goods or for the scientific transformation of methodologies or procedures.

" Technical progress ", is a result of the transfering of techniques and consists in a more economic and/or a more efficient organization of production or management processes.

Whenever a computer installation is managed not with restricted purposes (as can be the case in advanced countries where there are hundreds and even thousands of installed computers) but with a much wider variety of objectives and applications and with the purpose of maximizing its " technique transferring " function, a very rapid technical progress takes place through the dissemination of new techniques of management - sciences, of operations research, of multivariate statistics,- of automatic control theory, of information retrieval and many others, which before the active support from the computing center were, to a large extent, only academic developments to be read about.

2.2. Because of this, and taking into account the basic mechanisms of development described in the introduction, it is only logical that any program of international or regional scope,should be oriented to the fundamental objectives of maximizing the rate of " coupling " and of innovation at the functional level, and of maximizing the transferring of techniques, at the operational level.

2.3. When the particular field of the applications of computers to economic and social development is envisaged, the fulfilment of these objectives meets with several major difficulties: the imprecise concept of " development ", the diversity in the stages of planning for development and the variety among the objectives set forth for the formulation of the corresponding plans.

As natural, a programme to foster the applications of computers and data-processing machinery to economic and social development has to have two main aspects: one of a general nature, valid for every country and for any stage of planning for development and the other, of a more regional and even national nature, through which a decisive acceleration of the whole of the process could be achieved.

In this way, the first aspect would be devoted to disseminate and implement general knowledge about useful and desirable computer techniques (as statical data-reduction, population, files handling, information-retrieval methods, natural resources perpetual inventories, etc.,) and the methodologies indispensable for computer selection, installation, adaption, up-grading and operation.

The second aspect would be more " mission-oriented " as it be largely governed by the regional and/or national set of conditions, relating to the particular objectives set forth by the economic and social planning effort (if in existance), by the financial situation, by the particular " state of the art " in computer utilization and by the types of available educational institutions and personnel.

2.4. This clearly indicates that the United Nations are probably the only international body that could launch such a programme. And even for the U. N., it will require the pooling together of the resources of all of its branches (UNESCO, which already has made very important contributions in these field, FAO, which has made several successful attempts to utilize computers in national and regional development programmes; WHO, ILO, regional Economic Commissions, etc.) and of many international organizations which have not only made contributions but also have accumulated invaluable experiences bearing on these matters.

First among these international organizations is IFIP, whose international congresses every 3 years have provided ocassions for numerous " couplings", and whose International Seminars are, up to now, the only activity of educational nature with wide scope in attendance and in curricula.

Also of substantial importance, are IFAC, IAG, (which is an IFIP affiliated organization), ISIS (formerly FID), IFORS, the U.N. Computing Research Centre in Bratislava (Checoslovaquia) and ICC (which up to now has suffered from the lack of a sensible and clearly defined program which could appeal to existing and potential members, and has been largely subject to the " personal styles and wishes " of the succesive directors and as a result, has been languishing down without been able to make the important contribution which its structure and objectives theorically called for).

2.5. Wishing to make a constructive contribution, and at the risk of covering only in a partial way all of the possible ways and means through which the United Nations (and all the associated bodies they can rally-on for these purposes), could make a decisive contribution to the utilization of computers and data-processing machinery for development, the following scheme is submitted.

2.6. Organization

2.6.1. A network of Regional Computer and Information Sciences Institutes appear to be an indispensable vehicle.

These Institutes or Centers would be organized taking into account the best of the experiences derived from the regional Economic Commissions and of UNESCO's regional groups for Scientific Assitance, but with the natural specific characteristics asked for by the special nature of computer science and technology, of computer education and applications and, in special, for an effective and rapid fostering and support of their applications to economic and social developments.

At the same time, extreme care should be exercised to avoid the danger of creating a too bulky, rigid and complex administrative and operational structure, as computing systems activities are characterized by the very large necessary initial investments (in electronic equipment, in programming tasks, or in both). And a profitable operation requires of an agile, responsive and administratively simple organization, led by executives capable of developing and exercising a wide and daring initiative and staffed with personnel with rich experience and backgrounds, multidisciplinary in their way of thinking and fully capable of promoting and selling the purposes and services of these Institutes.

Because of this, it is strongly recommended to conceive and organize the structure charged with the implementation of these purposes (whichever it would be) based in a strict cost-effectivenes criterium and with clearly defined deadlines for reaching substantially self supported economic status.

Whichever this structure; centralized, regional or -- country wise oriented, the corresponding operational units - should receive only, from the United Nations or from any - - complex of contributing bodies, two kinds of financial supports: " seed money " to get established properly and that - will be only granted once; and " triggering or promotion-oriented money " destined to support the initial chores of major-projects programmed with the developing countries involved.- These last funds could be allocated along 1 to 3 years, by - example.

If the chosen structure happen to be the proposed one, the Institutes should have the following minimum requirements:

i. To be capable of initiate and implement the proposed and approved program.

ii. To be able to contribute either partially or - in full, to the payment of foreign scientists and expert salaries.

iii. To be able, technically and financially, to come to the rescue of any worthwhile computing center, contributing to developments, treatened by financial difficulties.

These Institutes (or Centers) would NOT be gratituously equipped with computer nor data processing gear, except in cases when located ,in countries where no access to adequate facilities could be secured. Whenever it proves necessary for them to have a computing system, a feasible plan for its financement should be worked out.

2.6.2. The major responsabilities of these institutes would be:

i. to formulate the censsuses of installations, of needs and of available personnel in every one of the countries within their scope. (It would not be advisable then, to assign a large number of countries to each one of them).

ii. To take over the dissemination of information and the coordination of relations among the different countries, and the promotion and enlargement of existing and future activities of international bodies with interested parties within the countries they encompass.

iii. To organize the implementation of those of these activities that have proven to be worthwhile (e.g.the

IFIP's International Seminars) within their assigned regions and in the appropiate languages and with the necessary facilities for the attendants to derive full benefits from such activities.

iv. To take over the development, translation and - editing in the appropiate languages of:

1.- Record, video-tape, radio, T.V., and mail courses.

2.- Multi-lingual glossaries and dictionaries.

3.- Selected books, brochures, etc.

All of these materials should be prepared for both, adult education and pre-university students (12 to 18 years old). The income derived from these courses through copy- - rights could contribute to the financement of the network of Institutes.

v. To organize the long-term visits, post-doctoral assignments and sabbatical leaves of graduate students and - experts and groups of experts and to take full responsibility for the assistance to the recipient centers in the necessary previous stages of " getting prepared " to receive these visits.

vi. To organize the flow of graduate and post-graduate students, to advanced countries which will take advantage of the available fellowships. To actively promote the -

granting and the creation of more fellowships, including those among developing countries.

vii. To organize, in collaboration with existing suitable groups within their respective regions, of " workshops ", " mission-oriented " symposia, " subject-in-depth " colloquia and interdisciplinary meetings.

viii. To work with governmental educational authorities from all the countries within their scope, in order to establish the most " universal " professional career possible or, at least, a flexible " Development Engineering " degree, with fullest international exchangeship possible.

(Master in Sciences and Doctoral Degrees could later on be added in the most adequate of the countries from their respective regions).

NOTE: Appendix 1 includes an experimental curriculum which the Latin American Institute for information and Computing Sciences has been developing in collaboration educational institutions from Mexico.

ix. To recommend to the Governing Council of the networks, which of the institutions from their respective regions should receive computing equipment, under what conditions, and with what extent of technical and scientific assitance.

(Cf. Governing Council)

x. To recommend to the Governing Council of the networks, which institutions within their respective regions should receive research and development equipment -- and teaching aids, for the training of designers of digital electronic devices (in special, interfaces and peripheral equipment) and of high level maintenance experts (conversant with components memories, inter-faces and enviromental equipments for computer installations).

xi. To organize " communities of universities "- within their regions, which could undertake systematic exchanges of information and ideas, and set-up " mission-oriented " study and research groups for concrete tasks -- within the general fields of:

1.- Study of the factors, mechanisms, methodologies and management of development and its planning.

2.- Study of the phenomena and factors (technological, economic, social, psychological, political and cultural) which characterize different identifiable levels - of underdevelopment.

3.- The set-up of the conceptual and operational basis for the new strategy (computer oriented and supported) of planning and its implementation, for development,- as well as for its management and periodic evaluation.

xii. The creation of " mobile class-rooms and/or computing centers " and of " mobile interdisciplinary - - groups of experts " (including foreign experts) which - could conduct " research and study with hand's-on experience " intensive (" immersion " type) courses, about the - applications of computers to the most general problems of planning for development (population, files, natural resources perpetual inventories, model building, urban development, preventive medicine planning, etc.)

xiii. To work with governmental authorities within their respective regions, to establish the necessary standards for equipments, for computer related consumer goods, (cards, tapes, disks, etc.,) labor tasks, etc., in accordance with the growing international hosts of standards - adopted within the computing and data-processing field.

xiv. To organize and maintain an Educational - - Unit in which comprehensive courses would be taught on -- Systems Design and Analysis, Building of Computer-models- for Development, advanced Programming techniques, Design- and Programming of Operative System and Computer Translators, Multivariate Statistical computer-oriented techniques, Data and Language structures, Design of Information Processing Systems, Sociopsychology of Development, Automation, and suitable concentration courses on related topics.

xv. To organize and operate, as part of the Educational Unit, an Automated Documentation Center specialized in Economic and Social Development, Planning for Development, Methodologies for the implementation and Management of surveys, programs and studies for development and Information and Computer Sciences.

xvi. To help in the definition and the organization of supra-national (and the corresponding national) data-banks on the bio-sphere comprehending, among others, files on data on outer-space, geographical (reismic, orographic, natural resources, etc.,), weather prediction, oceanographic, climatic, population (dynamics and mobility), capital goods producing machinery (machine-tools, etc.,); animal species mobility, etc., etc.

NOTE: This network of Automated Documentation Centers will distribute among themselves the necessary tasks for the gathering, indexing, abstracting, etc., of the necessary literature, and will regularly exchange their wealth of information in suitable form (punched paper tape, magnetic tape or any other advisable medium). In this eay, a substantial wealth of information can be gathered in a relatively short time. A secondary publication about the inventories of information kept, will also be a cooperative effort.

2.7. It is strongly recommended to organize these Regional Institutes as non-profit organizations but in such a way that they could become self-supporting to a large extent, after periods not exceeding of 3 to 5 years.

As an example of a possible arrangement, the necessary initial budgets(" seed " and " triggering funds ") could be-underwritten in adequate percentages from a specially integrated common fund (to which the U.N. Special Fund, the World - Bank, the rest of international and/or regional banks devoted to financement of development programs and the computer manufacturers could contribute) and by contributions from the -- governments of the respective regions.

If a three-years period to attain a self-supporting -- status is in principle considered, an arrangement such as the following could be established:

	U.N. Promoted Special fund	Governmental contributions	Own resources
1st year	70%	30%	--
2nd year	50%	40%	10%
3rd year	30%	50%	20%
4th year	--	60%	40%
5th year	--	40%	60%

Extreme care should be exercised in the appointment of the Directors of these Regional Institutes as they should not only be knowledgeable about computing sciences and techniques but also they must have substantial administrative experience.

2.8. " The own resources" from which the proposed self-supporting percentages of the operating (and steadily increasing) budgets could be derived from:

i. Sales of publications (censsuses of installations, multilingual glossaries, etc.,) from record - video tape, radio, T.V. and mail courses)

ii. Participation in the copyrights of publications, books translated, etc.

iii. Registration fees to workshops, symposia, colloquia, meetings, courses, etc.

iv. Honoraries derived from consulting and -- technical advising given by their permanent and "Mobile" staff, to governmental and private enterprises from countries within their respective regions.

v. Income derived from the operation of the Educational units.

vi. Sales of services (microphotocopies,copies, translations, bibliographies, etc.,) given by their Automated Documentation centers.

vii. Eventually, from computing services rendered in economic and social development related tasks.

2.9. Direction and Management

The Scientific and Technical directives for the networks of Institutes, could be conducted by Regional - -

Consulting and Advisary Councils each one integrated by a group of 5 to 10 distinguished experts in development, in planning and in computer sciences nominated by UNESCO,FAO, WHO and ILO, the U.N. Computing Research Center and other U.N. agencies, plys the Directors of the Regional Economic Institutes, by 2 to 3 representatives of the governments-included in each of the respective regions (whom could - rotate in rigorous alphabetic order) and by representatives of IFIP and ISIS (perhaps of some other International organizations). These Regional Councils will appoint, - - among their members, two members of the International Consulting Council.

The financial and administrative control of the proposed networks could be the responsibility of a Board of - Directors or Governing Council, integrated by members with "vote and voice rights" (officials appointed by the U.N. - by the contributing international banks and by the governments of developing countries, actively participating computer manufacturers etc.).

Each one of these two International Governing bodies would elect among their members, a Permanent Secretariat - which would act as an Integrated body when conducting their respective business between the (sixmonths apart) General Assemblies. One of the two annual General Assemblies will be a-

Joint General Assembly, attended by both Governing Councils.

2.10. A sample of the decisions and programmes which could be the responsibility of these Governing councils (offered only as an ilustration and not with a limitative or exhaustive criterium) would be:

i. The coordination of the activities of the networks of Regional Institutes.

ii. The formulation of catalogues of experts, professors and high-level technicians contemplating sabbatical leaves, comparatively long vacation periods, leaves of absence, etc., and their matching with the catalogues of needs contributed by the Regional Institutes.

This plan of distribution of experts, professors and high-level technicians has been developed in great detail, for Latin American countries, by the Latin American Institute for Information and Computer Sciences (ILACIC), but it will gladly pass it under the control of any U. N. sponsored body for world-wide application if it is considered as a worthwhile project.

In general terms, this plan offers these foreign experts a salary of Dls. 400.00 to Dls. 600.00 per month, for persons wishing to devote 6 to 9 months of their sabbatical leave in the recipient center of the developing country; Dls. 600.00 to Dls. 800.00 per month, if the duration of the stay goes from 9 to 12 months.

In both cases, furnished adequate lodging is covered also by the recipient center and, when necessary, the visiting expert is furnished with a vehicle for his daily transportation.

The necessary funds can be covered, in different proportions, by interested international bodies, by local governments and directly by the recipient center. In principle it has been thought as feasible to ask the developing country government to cover 60% of the expenses involved leaving, 25% and the cost of the lodging to the recipient center and 15% and the travel cost to the international supporting agency.

Following the indispensable rules about the indispensable program to " get prepared " for these visits, it has been envisaged that only those visits which could be prepared 9 to 12 months before the expert's physical arrival to the developing country, will be sponsored and processed by the international agency.

During the period of preparation, a carefully drawn " job description " and a corresponding time-table of related operations has to be worked out between the expert and the recipient center. An early definition of students, technicians, equipment, books and journals, etc., needed to fulfill the envisaged teaching and/or research and development program has to be drawn by both parties.

The international sponsoring body reserves to itself the right to supervise the preparatory stages, for both parties and to call off the arrangement if they do not progress or do not ensure a successful development of the envisaged-program.

iii. Integration of " mobile " multidisciplinary - " research-teaching " groups of experts to undertake well - defined development oriented projects of regional interest.

iv. Development of a program to enlist universities - and high-learning institutes from economically advanced -- countries, in a cooperative project according to which they would allocate 5 to 10% of their teaching and research personnel from Computing Centers, Departments of Information- and Computing Sciencies, of Operations Research and Management Sciences, of Digital Electronics and Computer Design, of Mathematical Economics, of Regional Development, Behavorial Sciencies and other related departments, to be put at the disposal of developing countries (through the Regional Institutes), for the helping to establish the - - appropiate definition and implementation of their computer oriented development programs and to increase the much -- needed academic mobility and the intelectual pemeeability of developing countries.

v. Development of a program to convince computer and perpheral equipment manufacturers to allocate a minimum of 20 to 30% of the used systems and machines of the " previous to the last " generation, which are completely or - - nearly completely amortized (and which are usually destoyed), for their installation in deserving institutions from developing countries (as per the recommendation submitted- to the Governing councils by the Regional Institutions).

vi. Development of a program to convince educational, research oriented, and non-profit organizations from - economically advanced countries to donate, or lend or lease their discarded computing systems, research and development equipments for digital electronics, advanced electronic - - equipment, teaching aids, etc., to be also installed at deserving institutions from developing countries as previously approved by the Governmental Councils, acting on the recommendations proposed by the Regional Institutes.

These two last programs have been envisaged by the - ILACIC, as the two parts of an Electronic"Tom Thumb Project" in which the two seven-leagues boots will be: hardware and experts.

vii. Assisting the Regional Institutes in raising the interest and rallying the governmental forces from developing countries, for giving proper and strong enough support to the acquisition and installation of computing gear and the associated operating costs. Regional Institutes will provide, directly or through their foreign experts, the necessary advise and expertise for the proper selection, installation and operation of the necessary machinery.

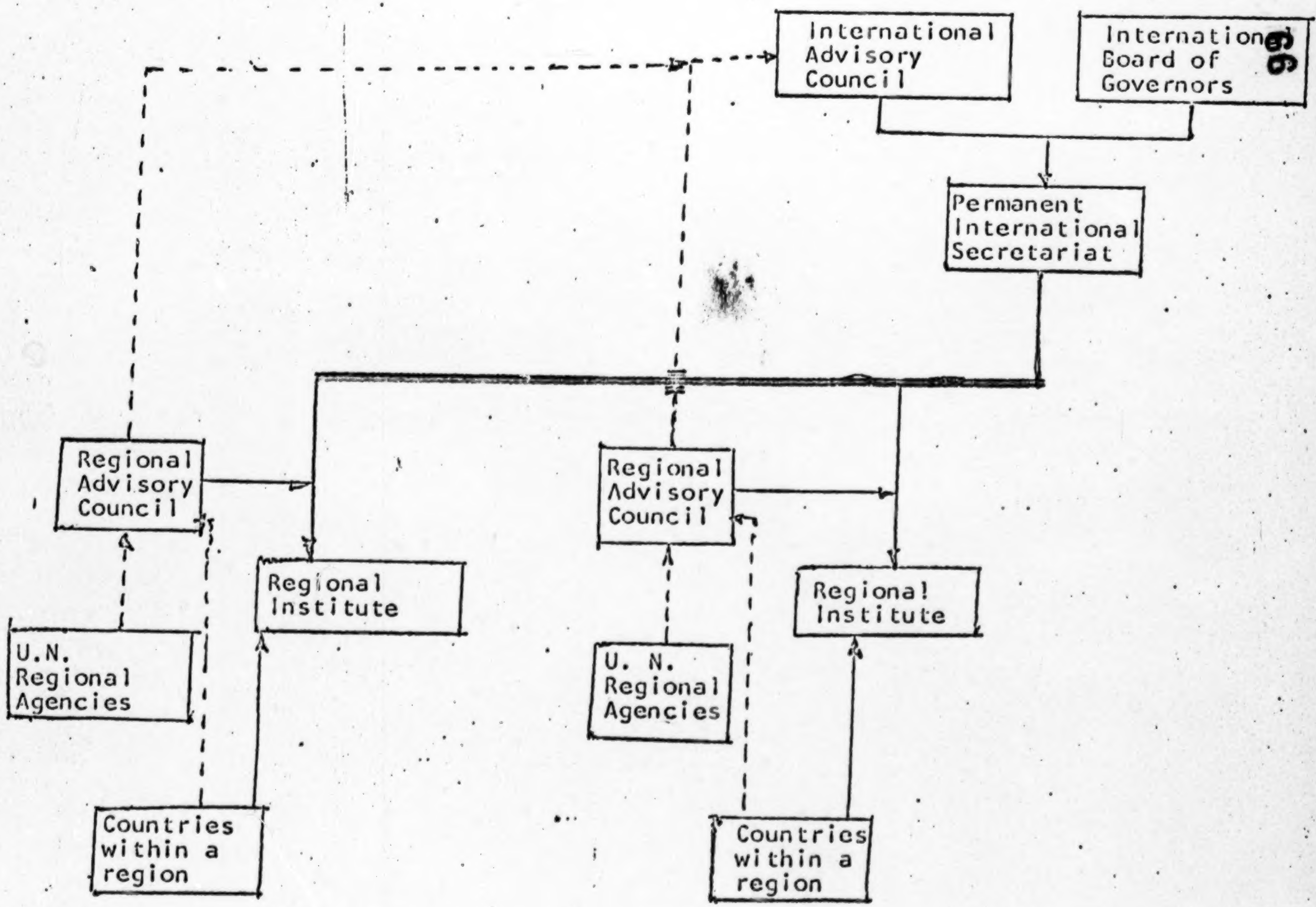
viii. To administer, enlarge and allocate the financial resources pooled together in the special fund which the initial financement of the Regional Institutes will be made.

ix. Planning the creation and development of "technology poles " within developing countries which could act as triggering factors " economic development poles ".

x. To elaborate a plan to faicilitate the custom free and tax-free exportation and importation of programmable desk caculatros, electronical digital computers, programs and programming systems in cards, tapes or disks, peripheral equipments and components, whenever they are meant for applications of computers to development.

Up to now, there are many countries which have an incredible amount of "red-tape" and custom taxes on all these products and which not having adhered to the Florence convention give them a conventional treatment when imported.

2.1. A detailed organization chart and a project of the necessary budget, could be submitted for consideration in case it is considered a useful contribution. The budget has been worked for a sample Regional Institute and separately for the Permanent Joint Secretariat and the two Governing Councils.


International Advisory Council
International Board of Governors
Permanent International Secretariat
Regional Advisory Council
U.N. Regional Agencies
Countries within a region
Regional Institute
Regional Advisory Council
U. N. Regional Agencies
Countries within a region
Regional Institute

APPENDIX 1

Project of Curriculum for Professional Career leading to the degree of " Development Planning Engineer "

(México, 1968)

1.- The proposed Curriculum has been devised keeping in mind the author's experiences about the needs of developing countries in the fields of planning for development and in the utilization of electronic computers and of mathematical models and techniques for the acceleration of the social and economic development.

2.- The curriculum is organized in 4 years (or 8 six month-terms) and would lead to an Engineering degree in Development, at the professional level (equivalent to a Bahcelor's degree in the United States educational system).

3.- Later on, curricula leading to Master in Sciences and Doctoral degrees will be developed and implemented.

4.- The detailed outlines of the proposed courses have been worked out in Spanish. The 4 (or 8) courses in Mathematics and Computing Sciences, have been devised with the strong believe that all of the classical material comprehending Differential and Integral Calculus, Higher and Modern Algebra, Differential Equations, Model building, Finite Mathematics, etc., can be taught (with great advantages) simultaneously with the teaching of symbol manipulation and information structures handling, algorithmic models and the design and building of programs, high level assembling languages, L. P. and matrix manipulation codes, compilers and operating systems.

5.- A final dissertation will be required prior to the granting of the professional degree.

6.- The approval to start this professional career (from the Mexican educational authorities) is expected before October 1969 as plans have been drawn to start it in the Fall of 1969.

CAREER FOR DEVELOPMENT PLANNING ENGINEERING

	Hs / wk	
First Year	Theoret.	Lab/Comtg. Ctr.
Mathematics and Computing Sciences	5	3
Physics 1	3	
Governmental Organization and Control Systems 1	3	
General Theory of Ecology	3	
Political Economy	3	
Regional Sociology	3	
Introduction to Law and Legislation	2	
Natural Resources	3	
	25	3
Second Year		
Mathematics and Computing Sciences II	5	3
Physics II	3	
Statistical Methods 1	3	2
Governmental Organization and Control Systems II	3	
Human Ecology	3	
Sociology	3	

General Theory of Planning	3	
	23	5
Third Year		
Mathematics and Computing Sciences III	5	3
Statistics II	3	2
Design of Organization and Control Systems	3	
Urban and Regional Planning	3	
Infraestructure Public Works	2	
Public Services 1	3	
Workshop on Economic and Social Planning	-	4
	19	9
Fourth Year		
Mathematics and Computing Sciences IV	5	3
Probability and Multivariate Statistics	3	2
Design of Organization and Control Systems II	2	
Integral Planning	3	
Public Services II	2	
Public Finances	2	
Applied Cibernetics and General Systems Theory	2	
Workshop on Economic and Social Planning	2	
	19	9